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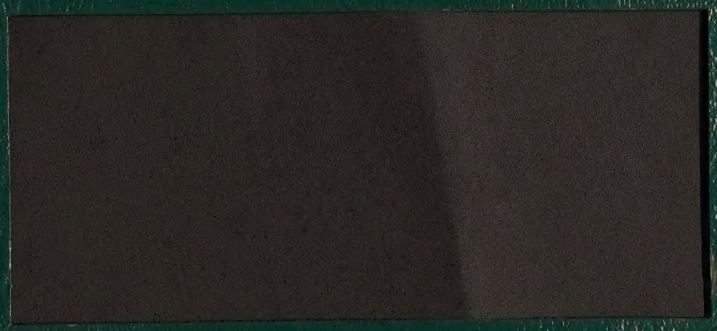


instructions

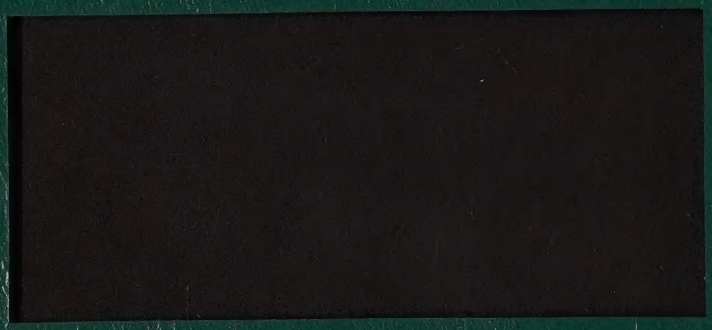
INSTALLATION
OPERATION
MAINTENANCE

HSB3H/HSB6H

DESIGNERS AND MANUFACTURERS OF

power equipment without moving parts

SUB-CYCLE® CONVERTERS AND FLOTROL RECTIFIERS



For Parts Or Service, Contact:

Lorain Products Corporation
Service Department
1122 "F" Street
Lorain, Ohio 44052
PH: (216) 288-1122
TWX: 810-426-2130

NOTE

PROGRAMMED PREVENTIVE MAINTENANCE Is Available On This And Other Lorain Products Manufactured Equipment. For Further Information, Contact "Service Manager" At The Above Address.

LORAIN MODEL HSB6H

DC TO DC CONVERTER

Spec. No. 5664-023 Serial No. _____

LORAIN PRODUCTS CORPORATION WARRANTY

Lorain Products Corporation warrants that all equipment manufactured by it shall be free from defects in material and workmanship. The corporation will, at its option, replace or repair free of charge and pay surface carrier charges on any adequately packed equipment covered by its warranty which shall be returned to the factory within 90 days from date of turn-on and found to be defective. All circuit components are warranted for two years from the original shipping date from the factory and which upon examination prove to be defective in material or workmanship. The corporation recommends that all shipments of equipment be inspected by the customer for hidden damage upon receipt from the carrier to insure that a timely claim be filed, if necessary, by the customer. Lorain Products Corporation will not pay claims for shipping damages.

Systems and Equipment Not Economically Returnable To The Factory

In the event that the product involved is a system or equipment which, in the judgment of Lorain Products Corporation, is not economically returnable to the factory or if Lorain Products Corporation has performed the installation, supervised the installation, or performed testing and turn-on, circuit components and Lorain repair labor are covered by this warranty for the first 90 days from date of turn-on and circuit components are warranted for two years from the date of shipment. Upon request, Lorain will send a service technician to the site to determine if the unit is defective in circuit components or workmanship, and will repair the equipment. If the failure is Lorain's fault, no invoice for circuit components or repair labor will be issued if the complaint has been issued within the first 90 days from date of turn-on. If the complaint is issued more than 90 days from the date of turn-on but within two years from the date of shipment, the customer will be billed at the prevailing Customer Service rates but will not be billed for circuit components. If the problem occurs after two years from the date of shipment, circuit components and repair labor are billable.

If the problem has been created by misuse or abuse of the equipment or by malfunction of associated equipment or by environmental conditions, at any time after shipment, the customer will be billed for circuit components and labor.

General Provisions

Lorain Products Corporation shall not be obligated to pay any costs or charges incurred by the customer or by any other party. In no event will Lorain Products Corporation be liable for consequential damages. No waiver, alteration or modification of any of the provisions herein shall be binding on Lorain Products Corporation unless in writing and signed by an authorized official of Lorain Products Corporation. If, during any warranty period, the subject equipment has, in the opinion of Lorain Products Corporation, been modified or misrepaired, the warranty will be void unless the modifications or repairs have been made after consultation with the corporation and upon the recommendation of the corporation.

1. SPECIFICATION

1.1 GENERAL: This DC to DC Converter changes 48 volts (positive ground) to 130 volts DC for either positive or negative grounded systems.

1.2 OUTPUT RATINGS

1.2.1 Voltage: Negative or positive 130 volts DC nominal. Adjustable over the range of 123.5 to 136.5 volts.

1.2.2 Regulation

(A) Static: Steady state output voltage remains within ±1% of the adjusted voltage for any load current from no load to full load for the input voltage range of 42 to 56 volts DC.

(B) Dynamic: For a step load change of 50% of full load within the range of 10% to 100% of full rated current, the maximum voltage transient will not exceed 5% of the initial steady state voltage.

1.2.3 Filtering

(A) Voice Band: Noise is less than 26 dBrn C message.

(B) Wide Band: Does not exceed 1.3 volts peak to peak over the frequency range of 10 Hz to 50 million Hz.

1.2.4 Current: 6 amperes

1.3 INPUT RATINGS

1.3.1 Voltage: 48 volts DC (positive ground) — Will operate over a range of 42 to 56 volts DC. This converter will tolerate a range of 40 to 60 volts DC without operating a fuse or creating component damage.

1.3.2 Filtering: Noise reflected back to a 100 ampere hour battery is less than 26 dBrn.

1.3.3 Typical Input Currents

(A) No Load: 0.5 amperes at 48 volts DC

(B) Full Load: 19.2 amperes at 48 volts DC

(C) Does not exceed 24.2 amperes at maximum overload and the input voltage within the range of 42 to 56 volts DC.

1.4 STANDARD FEATURES

1.4.1 Input Protection

(A) Undervoltage: Low battery voltage sensing circuit causes output voltage and current to be reduced to zero when the input voltage goes below 37 volts. Output current is automatically restored up to maximum overload when input voltage goes above 42 volts.

1.4.2 Output Protection

(A) Short Circuit: One 10 ampere Bussmann Type BAF fuse.

(B) Current Limiting: Circuit limits DC output current to 110% of full rated load. Adjustable from 100% to 110% of full load.

(C) Overvoltage: Voltage trip circuit breaker and high voltage sensing circuit disconnects the input voltage when the output voltage exceeds 136.5 volts.

1.4.3 Audible Noise: Operating frequency beyond audible range.

ISSUE	CHG. NO.	DESCRIPTION
4	1836092	No load input current increased CJM 5-21-76
3	1835984	Undervoltage corrected CJM 4-28-76 Mtg. Angle redesigned
2	183-5693	Undervoltage trip circuit added
1	—	New

REVISIONS

LORAIN PRODUCTS CORPORATION
LORAIN, OHIO
LORAIN PRODUCTS (CANADA) LTD., ST. THOMAS, ONTARIO

POWER DATA
MODEL HSB6H DC TO DC CONVERTER
SPEC. NO. 5664-023

DR. BY	DATE	ENGR. BY	DATE
		D. KAMMERER	9-15-75
CH. BY		APP. BY	9-15-75
		ECN APP'L	5-21-76

PD5664-023

1. SPECIFICATION

1.4.4 **Meters**

(A) 0-150 volt, 2-1/2 inch rectangular type DC voltmeter, ±2% accuracy of full scale, MODUTEC (or equivalent), 2.41 inch scale length.

(B) 0-10 ampere, 2-1/2 inch rectangular type DC ammeter, ±2% accuracy, MODUTEC (or equivalent), 2.41 inch scale length.

1.4.5 **Series Output Diode:** Output diode may be connected in either negative or positive lead which enables paralleling with other converters. Load may not be shared proportionately between paralleled units. Failure in one converter will not affect the others.

1.4.6 **Alarms**

(A) If the output voltage exceeds a preset limit, circuits cause two alarm circuits to close, ground to be made available for two alarm circuits, a CONVERTER FAILURE lamp to light and the converter to be turned off.

(B) If the input or output voltages goes below a preset limit or the converter is manually turned off, circuits cause two alarm circuits to close, ground to be made available for two alarm circuits and a CONVERTER FAILURE lamp to light.

1.4.7 **Mounting:** Universal angle provided for either 19 inch (1-3/4 inch multiple drilling) or 23 inch (1 inch or 1-3/4 inch multiple drilling) relay rack mounting.

1.5 ENVIRONMENTAL RATINGS

1.5.1 **Operating Ambient Temperature Range:** 0°C to +50°C (+32°F to +122°F)

1.5.2 **Storage Temperature Range:** -20°C to +65°C (-4°F to +149°F)

1.5.3 **Heat Dissipation:** 483 BTU/HR (48 volt input at 130 volt output and full load).

1.5.4 **Ventilation Requirements**

(A) **Ventilation:** This converter should be mounted so that bottom and top ventilating openings are not blocked and air entering the bottom of the cabinet does not exceed +50°C (+122°F)

(B) **Spacing:** It may be necessary to allow a minimum of 1-3/4" spacing between this converter and other heat producing equipment.

(C) **Stacking:** A maximum of six converters may be stacked, one above the other, 1-3/4" minimum spacing. Additional converters may be stacked providing a baffle plate or increased spacing is used.

1.6 ACCESSORIES: Available for use with this DC to DC Converter — None

1.7 MISCELLANEOUS

1.7.1 **Schematic Diagram:** SD5664-023

1.7.2 **Wiring Diagram:** T5664-023

1.7.3 **Instructions:** Section 3441

2. DIMENSIONS

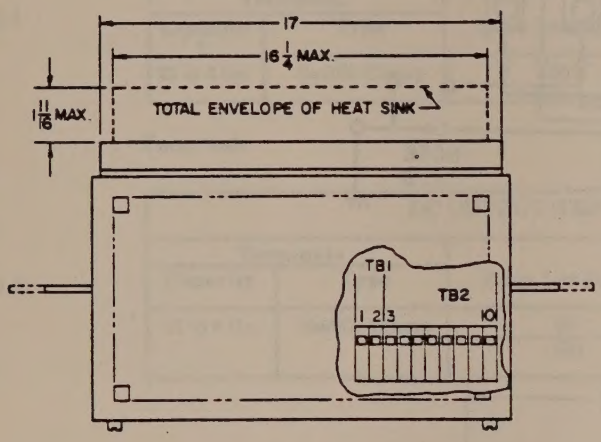


FIG. 3
TOP VIEW

NOTES

1. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.
2. WEIGHT
   (A) SHIPPING: 31 LBS
   (B) NET: 26 LBS
3. FINISH: EQUIPMENT LIGHT GRAY.
4. INDICATES VENTILATING GRILLE

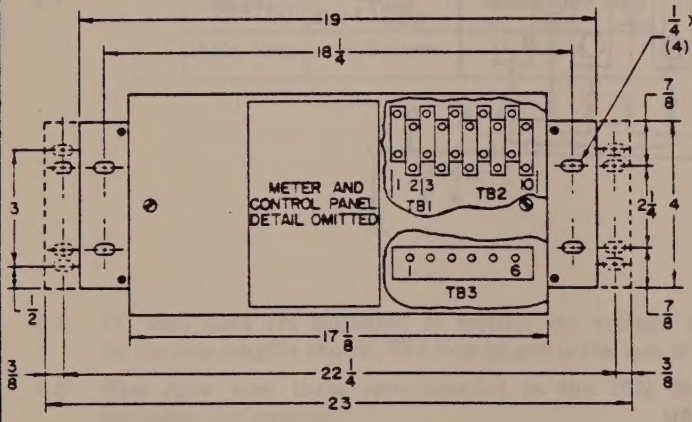


FIG. 1
FRONT VIEW

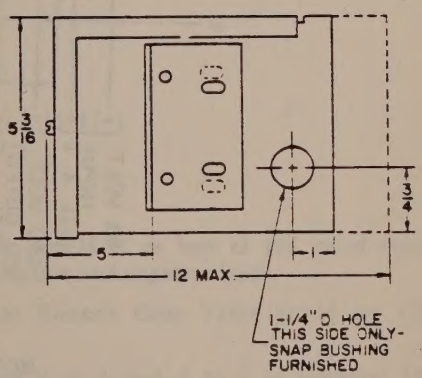
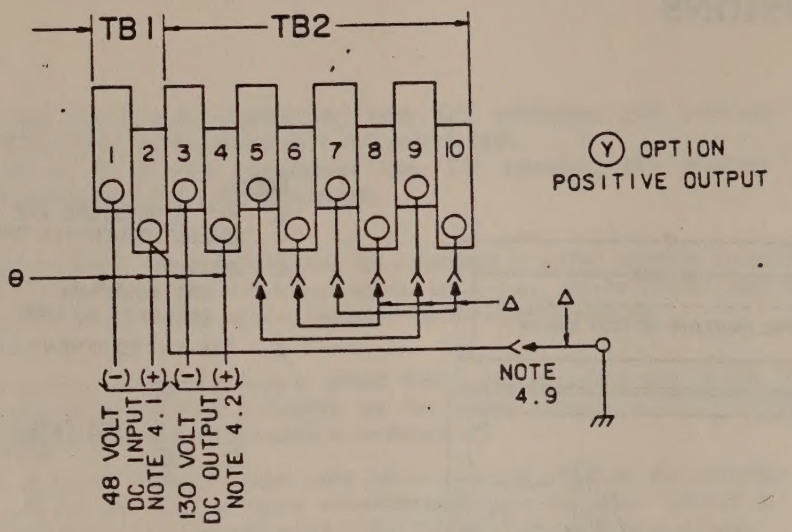
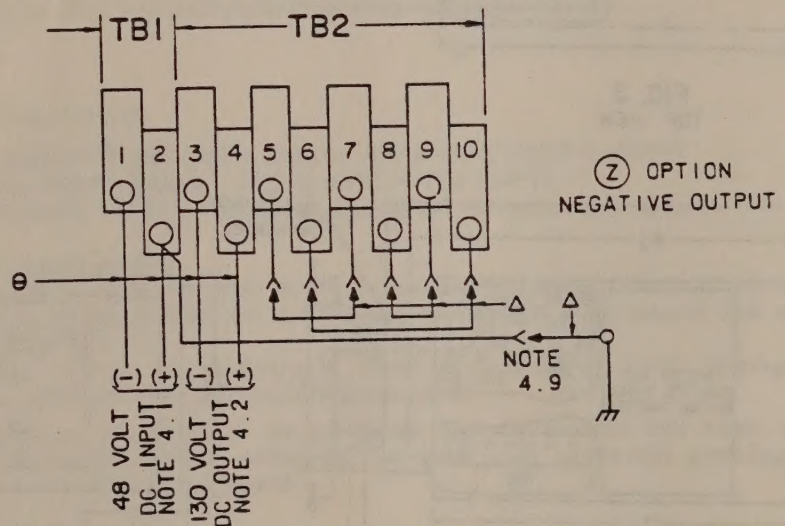
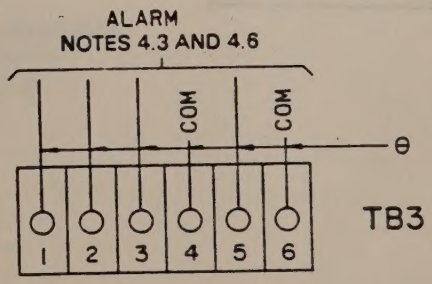


FIG. 2
SIDE VIEW

3. INSTALLATION CONNECTIONS







4. INSTALLATION NOTES

4.1

DC INPUT (TB1)				
Terminals		Loop Length-Ft	Recm Wire Size	Recm Fusing
Capacity	Type			
22 to 8 Ga.	Saddle Clamp	50	8 Ga.	30 amperes

Terminals

4.2

DC OUTPUT (TB2)			
Terminals		Loop Length-Ft	Recm Wire Size
Capacity	Type		
22 to 8 Ga.	Saddle Clamp	50	14 Ga.
		100	12 Ga.

4.3

ALARMS (TB3)		
Terminals		Recm Wire Size
Capacity	Type	
16 Ga. Max.	6-32 Screw	18 Ga.

4.4 DC wire sizes are sufficient to restrict the voltage drop to one volt or less at full rated current for the loop lengths shown. The loop length is the sum of the positive and negative leads.

4.5 Wire sizes meet those recommended in the 1975 National Electric Code Table 310-16 for +75°C conductor temperature.

4.6 Alarm condition causes circuits to close between terminals 3 to 4 and 5 to 6 of terminal block TB3. Ground is also furnished at terminals 1 and 2 of terminal block TB3.

4.7 △ indicates wiring furnished with the converter to be installed by the customer.

4.8 ⊖ indicates wiring furnished and installed by the customer.

4.9 Positive ground to chassis provided by jumper. Removal optional after installation.

"HSB" SERIES
DC TO DC CONVERTERS

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1. MODEL DATA

General

1.01 Refer to the appropriate Power Data Sheet for information concerning the input and output ratings, operating limits, dimensions, recommended input and output lead sizes, fusing, and terminal lug capacity for the following D-c to D-c Converters:

Model	Spec. No.
HSB3H	5664-022
HSB6H	5664-023
HSB8B	5653-027
HSB16A	5635-007
HSB16B	5653-028
HSB16B	5653-030
HSB30A	5645-002
HSB8A	5625-003

2. TEST APPARATUS

Test Load, LORAIN Model Y4, Spec. No. 5883-107, or equivalent

3. DESCRIPTION

General

3.01 This DC to DC Converter operates from nominal 48 volts DC to provide filtered and regulated DC to the load. This Converter is a compact unit designed with a high frequency switching circuit to maintain audible noise levels to an absolute minimum.

3.02 This Converter is equipped with a high voltage shutdown/low voltage alarm circuit. In the event of a high output voltage condition, the Converter will shutdown; while a low output voltage condition will cause an alarm to be extended.

3.03 A low battery sensing circuit causes output voltage and current to be reduced to zero when the input voltage goes below 37 volts. Output current capability is restored up to maximum rated load when input voltage goes above 42 volts.

3.04 This Converter is also equipped with a current limiting circuit which will prevent further increase of output current above a predetermined (adjustable) level.

Accessories

3.05 An accessory for Model HSB16A, Spec. No. 5635-007 only, is available for changing the output voltage adjustable range from 22.8 - 25.2 to 25.17 - 27.83. This option is designated "X" on Drawing SD5635-007.

3.06 An accessory for Model HSB30A, Spec. No. 5645-002 only, is available for changing the output voltage adjustable range from 22.8 - 25.2 to 20.0 - 24.0 volts. This option is designated "X" on Drawing SD5645-002.

4. INSTALLATION

Location

4.01 This DC to DC Converter will operate best in a well ventilated area which has an ambient temperature range of 0°C (32°F) to 50°C (122°F).

> CAUTION: In mounted position, ventilation openings at the top and bottom of the converter cabinet must be unobstructed. This is essential for proper cooling during operation. The temperature of air entering the cabinet must not exceed 50°C (122°F). Refer to Power Data Sheet for spacing and baffle plate requirements.

Mounting

4.02 This Converter is designed for mounting in 19 or 23 inch relay racks.

Electrical Connections

4.03 Installer's input, output, and alarm connection terminals are accessible by removing the front cover of the unit. The terminal blocks are located at the front right side of the unit. Installer connections are shown on the Power Data Sheet.

5. ADJUSTMENTS

General

5.01 All adjustment potentiometers are located on the plug-in circuit cards at the front left side of the unit. All adjustments can be made without removing the circuit cards from the unit.

Output Voltage Adjustment

5.02 The output voltage adjustment potentiometer OUTPUT VOLTAGE (R3),

located on circuit card VCR-A3, sets the output voltage level of the DC to DC Converter. Unless otherwise specified on the order, the output voltage has been factory adjusted to the output voltage given in Table A. Should readjustment become necessary, follow the procedure below.

a) Adjust the output voltage to the desired level by means of potentiometer OUTPUT VOLTAGE (R3). The output voltage can be monitored using output voltmeter M1.

b) To increase output voltage, turn screwdriver adjustment shaft of potentiometer R3 clockwise; to decrease output voltage, turn adjustment shaft counterclockwise.

Current Limit Adjustment

5.03 The current limiting adjustment potentiometer OUTPUT CURRENT (R13), located on circuit card VCR-A3, sets the value at which the output current limit circuit will prevent further increase of output current. Unless otherwise specified on the order, the current limit point has been factory adjusted to the value given in Table A. Should readjustment become necessary, follow the procedure below.

a) The load on the Converter must exceed the desired current limit setting. A resistive test load of adequate size may be connected to terminals 3 and 4 of TB2, if additional load is required during adjustment procedure.

CAUTION: DO NOT ADJUST THE TEST LOAD BEYOND THE 110% OUTPUT CURRENT LEVEL.

b) Turn screwdriver adjustment shaft of potentiometer R13 fully counterclockwise.

c) While observing the DC output ammeter M2, turn screwdriver adjustment shaft of potentiometer R13 clockwise, slowly, until the output current increases to desired current limit value.

CAUTION: DO NOT ADJUST CURRENT LIMIT LEVEL ABOVE 110% OF RATED LOAD.

High Voltage Shutdown Adjustment

5.04 The high voltage shutdown adjustment potentiometer HIGH VOLTAGE SHUTDOWN (R2), located on circuit card HVS/LVA-A4, sets the value of output voltage at which the Converter will shutdown. Unless otherwise specified on the order, the high voltage shutdown limit has been factory adjusted to the voltage given in Table A. Should readjustment become necessary, follow the procedure below.

a) It may be necessary to disconnect the load from the Converter output to perform this adjustment.

b) Turn screwdriver adjustment shaft of potentiometer HIGH VOLTAGE SHUTDOWN (R2) fully clockwise.

c) Increase the output voltage of the Converter to the desired shutdown value, by turning screwdriver adjustment shaft of potentiometer OUTPUT VOLTAGE (R3), located on circuit card VCR-A3, clockwise.

d) Turn screwdriver adjustment shaft of potentiometer R2 clockwise until input circuit breaker CB1 opens.

e) Return potentiometer OUTPUT VOLTAGE (R3) to its original setting and close input circuit breaker CB1.

Low Voltage Alarm Adjustment

5.05 The low voltage alarm adjustment potentiometer LOW VOLTAGE ALARM

Model & Spec.	Output Voltage, Volts	Current Limit, %	High Voltage Shutdown, Volts	Low Voltage Alarm, Volts
HSB3H 5664-022	130	110	136-137	123-124
HSB6H 5664-023	130	110	136-137	123-124
HSB8B 5653-027	48	110	51.8-52.6	45.4-46.2
HSB16A 5635-007	24	110	25-25.4	22.6-23
HSB16A 5635-007 e/w "X" Option	26.5	110	26.6-28.0	25-25.4
HSB16B 5653-028 5653-030	48	110	51.8-52.6	45.4-46.2
HSB30A 5645-002	24	110	25-25.4	22.6-23
HSB8A 5625-003	24	110	25-25.4	22.6-23
HSB30A 5645-002 e/w "X" Option	22	110	22.9-23.3	20.7-21.1

TABLE A
FACTORY SETTINGS

(R1), located on circuit card HVS/LVA-A4, sets the value of output voltage at which lamp CONVERTER FAILURE will illuminate and extend an external alarm, if connected. Unless otherwise specified on the order, the low voltage alarm limit has been factory adjusted to the value given in Table A. Should readjustment become necessary, follow the procedure below.

a) Turn screwdriver adjustment shaft of potentiometer LOW VOLTAGE ALARM (R1) fully counterclockwise.

b) Decrease the output voltage of the Converter to the desired alarm value by turning screwdriver adjustment shaft of potentiometer OUTPUT VOLTAGE (R3), located on circuit card VCR-A3, counterclockwise.

c) Turn screwdriver adjustment shaft of potentiometer R1 clockwise, slowly, until lamp CONVERTER FAILURE illuminates.

d) Return potentiometer OUTPUT VOLTAGE (R3) to its original setting.

Gain Adjustment

5.06 The gain adjustment potentiometer GAIN ADJ (R3), located on circuit card DRV-A1, sets the Converter regulation control loop gain. This potentiometer has been factory set as required and field adjustment is not recommended.

Low Battery Shutdown Adjustment

5.07 The Low Battery Shutdown Adjustment potentiometer (R28), located on circuit card DRV-A1, sets the value of input voltage at which the Converter will shutdown. This limit has been factory set at 37 volts DC and field adjustment is not recommended.

Instantaneous Current Limit

5.08 The instantaneous current limit adjustment potentiometer (R30), located on circuit card DRV-A1, sets the instantaneous value of current limit the Converter will tolerate during transient current conditions. This limit has been factory set as required and field adjustment is not recommended.

6. OPERATION

General

6.01 This DC to DC Converter operates from nominal 48 volts DC to provide filtered and regulated DC to the load. An output wiring option allows the user to select either positive or negative output. Since the Converter operates without moving parts, it requires no periodic maintenance or adjustment.

Starting and Stopping

6.02 To start or stop Converter operation, place circuit breaker CB1 in the ON or OFF position, respectively. The circuit breaker is located on the front panel directly below the meters.

Metering

6.03 This DC to DC Converter is equipped with an output voltmeter (M1) and ammeter (M2) which continuously indicate output voltage and current, respectively.

Local Alarms

6.04 CONVERTER FAILURE: Lamp CONVERTER FAILURE (LED1) will illuminate during a high voltage shutdown, low voltage alarm, low battery shutdown or converter output failure.

Remote Alarms

6.05 High Voltage Shutdown and Low Battery Shutdown: Terminals 3 to 4 and 5 to 6 provide closed circuits; while positive battery is provided at terminals 1 and 2 of terminal block TB3 during a high voltage shutdown condition. Circuit breaker CB1 must be reset manually by placing it in the ON position to resume operation. For a description of the low battery sensing circuit (shown on the schematic diagram as "low battery shutdown"), refer to Para. 3.03.

6.06 Low Voltage Alarm: Terminals 3 to 4 and 5 to 6 provide closed circuits; while positive battery is provided at terminals 1 and 2 of terminal block TB3 during a low voltage alarm condition.

Fuses

6.07 The following table lists the function, size, and type of each fuse used in this DC to DC Converter. If replacement becomes necessary, use only the size and type listed, or equivalent.

Function	Size (Amps)	Type
F1 DC OUTPUT	20 (HSB16A, HSB16B)	Bussmann BAF
	40 (HSB30A)	Bussmann ABU
	10 (HSB8A, HSB8B, HSB6H)	Bussmann BAF
	5 (HSB3H)	Bussmann BAF

Component Boards

6.08 Any of the following component boards can easily be replaced as individual assemblies in the event of a failure of some component on a component board.

Component Boards

DRV-A1 (4338-281)	Driver Circuit
*PA-A2 (4337-325)	Power Amplifier Assy
**PA-A2 (4337-039)	Power Amplifier Assy
VCR-A3 (4865-611)	Voltage/Current Regulator Circuits
***VCR-A3 (4865-629)	Voltage/Current Regulator Circuits
HVS/LVA-A4 (4863-760)	High Voltage Shutdown/Low Voltage Alarm Circuits

*In Models HSB16A (5635-007), HSB8B (5653-027), HSB8A (5625-003), and HSB3H (5664-022) only.

**In Models HSB16B (5653-028 and 5653-030), HSB30A (5645-002), and HSB6H (5664-023) only.

***In Model HSB8A (5625-003) only.

7. CIRCUIT DESCRIPTION

General

7.01 The appropriate schematic diagram shows the electrical and functional circuits of these "HSB" Series DC to DC Converters.

Input Filter

7.02 Choke L1, diodes CR1 and CR2, and capacitors C1-C6 and C14 (or C16) form an input filter which will suppress any transient input voltages to the Converter.

Power Amplifier PA-A2 (4337-325)

7.03 A portion of the d-c input is applied to the power amplifier assembly where the d-c voltage is controlled by transistors Q1 and Q2, and is then applied to transformer T1.

7.04 Transistors Q1 and Q2 operate in a switching mode amplifying a quasi square wave signal generated by the driver circuit card DRV-A1, described later. This amplified square wave is then applied to power transformer T1 primary. Resistors R1-R3, R16, capacitors C1-C3, and diodes CR1 and CR2 suppress voltage spikes across the collectors of transistors Q1 and Q2.

Power Amplifier PA-A2 (4337-039)

7.05 A portion of the d-c input is applied to the power amplifier assembly where the d-c voltage is controlled by transistors Q1-Q4, and is then applied to transformer T1.

7.06 Transistors Q1-Q4 operate in a switching mode amplifying a quasi square wave signal generated by the

driver circuit card DRV-A1, described later. This amplified square wave is then applied to the power transformer T1 primary. Resistors R1-R3, R16, capacitors C1-C3, and diodes CR1 and CR2 suppress voltage spikes across the collectors of transistors Q1-Q4.

Output Circuit

7.07 The applied square wave of transformer T1 primary is induced on the power secondary windings of T1, which are connected to a rectifying network. This rectified DC voltage is then applied to the output terminals of the Converter.

7.08 The positive output is applied through inductor L2 while the negative output is applied through ammeter M2. If positive output is required, series diode CR3 and output fuse F1 will be in the positive line; likewise, if negative output is required, series diode CR3 and output fuse F1 will be in the negative line.

7.09 Series diode CR3 isolates the DC to DC Converter from any parallel connected Converters, thus preventing disturbance of bus voltage by a failed parallel connected Converter. Shunt diode CR6 (in some models) prevents complete loss of bus voltage in boost mode operation due to a failed Converter.

Driver Circuit DRV-A1 (4338-281)

7.10 The driver circuit produces the quasi square wave which is applied alternately to the power transistors located in the power amplifier circuit described above.

7.11 Clock A1 generates a 40 KHz pulse which is applied to voltage/pulse width Converter A1 generating a ramp. The slope of the ramp is determined by the current through resistor R12. This current is proportional to the input battery voltage. The width of the pulse generated by the VPW Converter A1 is determined by the slope of the ramp, by transistor Q6, and by the conduction of photo-coupler Q1. Photo-coupler Q1 is controlled by the regulator circuit. Transistor Q6 is controlled by the instantaneous collector current in the power amplifier circuit. Flip-flop A2 generates a 20 KHz square wave from the pulse produced by clock A1. The clock pulse, VPW converter output, and the square wave are combined in NAND gate A3 to form two out-of-phase variable quasi square waves. The two quasi square waves and their complement are buffered by A4. The quasi-square waves are amplified by transistors Q2-Q5 which operate in a constant current mode while their complement is amplified by transistors Q7 and Q8 which operates as a clamp on transformer T1 primary. Diodes CR12-CR14 provide bias for the amplifier transistors and provide voltage for circuits A1-A4 operation. Windings 1, 2 and 3, 4 of transformer T1 provide base drive voltage; while winding 9, 10 of transformer T1 provides power to operate the regulator and alarm circuits.

7.12 Battery voltage is applied to a voltage divider consisting of resistor R26 and potentiometer R28. When the divider voltage increases sufficiently to overcome the voltage across zener diode CR17, transistor Q10 will conduct. Transistor Q10, conducting, will bias transistor Q9 off, thus allowing capacitor C13 to charge. When capacitor C13 becomes fully charged, the VPW Converter A1 will begin to deliver maximum pulse width, which will result in full output power of the Converter.

7.13 Any instantaneous current surges are detected by the current transformer, located in the power amplifier circuit, and converted to a voltage which is applied to diodes CR20-CR23. This rectified voltage is then applied across capacitor C6. When the charge across capacitor C6 exceeds the reference voltage of zener diode CR11, transistor Q6 will begin to conduct. The conduction of transistor Q6 will reduce the conduction angle through diode CR18 and lower the clock frequency through diodes CR19 and resistor R19.

Voltage/Current Regulator Circuits VCR-A3 (4865-611 and 4865-629)

7.14 The voltage/current regulator circuits monitor the output voltage and current of the Converter. The outputs of these two circuits are combined to provide the controlled oscillator with the error signal which will control the output voltage and current.

7.15 Comparator A1G3 compares the signal developed across resistor R2 and potentiometer R3, which is proportional to the output voltage, to a reference voltage developed across zener diode CR3. Comparator A1G1 compares the signal developed across resistor R17 and potentiometer R13, which is proportional to the output current, to the reference voltage developed across resistor R16. The comparators output are combined through diodes CR1 and CR2 to form an "OR" function. Whichever output is more positive at any instant controls the photo-coupler on the driver circuit card. Regulator A1G2 functions as a series regulator for the isolated supply voltage developed across capacitor C5 and supplies voltage to zener diode CR3 and the photo-coupler on DVR-A1. Diodes CR4-CR11 comprise alternate rectifiers for the 20 KHz power from the driver circuit and the output circuit.

High Voltage Shutdown/Low Voltage Alarm HVS/LVA-A4 (4863-760)

7.16 The HVS/LVA-A4 circuit card monitors the d-c output voltage of the Converter. The circuit card contains two circuits; one that will cause the Converter to shutdown due to a high output voltage and one that will cause an alarm to be extended due to a low output voltage.

7.17 D-c output voltage is applied across resistor R4 and potentiometer R2 which is adjusted for a high voltage shutdown level. When the output voltage increases, the reference voltage developed across zener diode CR3 will remain stable, thus this difference between the voltage across potentiometer R2 and zener diode CR3 will be detected by comparator A1G1. Comparator A1G1 will swing positive causing light sensitive transistor Q1 to stop conducting, biasing transistor Q2 off and Q3 on. Conduction of transistor Q3 will cause ground to be applied to the trip coil of circuit breaker CB1, thus causing the Converter to shutdown.

7.18 D-c output voltage is applied across resistor R4 and potentiometer R1 which is adjusted for a low voltage alarm level. When the output voltage decreases, the reference voltage developed across zener diode CR3 will remain stable, thus this difference between the voltage across potentiometer R1 and zener diode CR3 will be detected by comparator A1G2. Comparator A1G2

will swing negative causing light sensitive transistor Q4 to stop conducting, biasing transistors Q5 and Q6 off. Non-conduction of transistor Q6 will cause relay K1 to de-energize. Contacts of relay K1, de-energized, will provide two closed circuits and supply ground at two for activation of external alarms, if connected.

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ELECTRICAL PARTS LIST
LORAIN MODEL HSB6H DC TO DC CONVERTER
SPEC. NO. 5664-023

This Electrical Parts List is arranged alphabetically by part name. Spare parts are not usually required if adequate standby equipment is available and if the LORAIN EQUIPMENT is installed at an accessible location so that parts can readily be obtained from Lorain Products stock. When ordering parts, please furnish equipment Model No., Spec. No., and Serial No. as given on the equipment nameplate. The quantity of spare parts listed should be sufficient for ten or less assemblies or models for at least 18 months. If a single asterisk (*) appears in the Quantity Recm. Spares column, it indicates the part, assembly, or model is listed more than once, in which case, use the quantity where the item first appears. If two asterisks (**) appear, refer to the sub-list for that assembly or model. If a dash (-) appears, this indicates that spares are not recommended for this part or assembly.

Ref. Desig.	LPC Part No.	Description	Quantity Recm. Spares
ASSEMBLIES			
A1	4338-281	Driver PW Board	1
A2	4337-039	Power Amplifier PW Board	1
A3	4865-611	Voltage/Current Regulator PW Board	1
A4	4863-760	High Volt Shutdown/Low Volt Alarm PW	1
LED1	4257-022	LED Circuit Board	1
CAPACITORS			
C1	2731-106	10UF 100 Volt, Electrolytic	-
C2	2713-173	1UF 100 Volt DC	1
C3	2731-318	6800UF 75 Volt, Electrolytic	-
C4	2724-140	0.01UF 1000 Volt DC	1
C5	2724-140	0.01UF 1000 Volt DC	*
C6	2724-106	0.1UF 500 Volt DC	1
C7	2724-105	100PF 500 Volt DC	1
C8	2724-137	4700PF 500 Volt DC	1
C9	2724-106	0.1UF 500 Volt DC	*
C10	2731-670	290UF 200 Volt, Electrolytic	-
C11	2724-105	100PF 500 Volt DC	*
C12	2724-105	100PF 500 Volt DC	*
C13	2724-106	0.1UF 500 Volt DC	*
C14	2724-105	100PF 500 Volt DC	*
C15	2724-106	0.1UF 500 Volt DC	*
C16	2724-106	0.1UF 500 Volt DC	*

ELECTRICAL PARTS LIST
LORAIN MODEL HSB6H DC TO DC CONVERTER
SPEC. NO. 5664-023

Ref. Desig.	LPC Part No.	Description	Quantity Recm. Spares
CIRCUIT BREAKERS			
CB1	2566-114	25 Amp 32 Volt DC	1
DIODES			
CR1	2812-223	1N5059, Silicon	2
CR2	2812-223	1N5059, Silicon	*
CR3	2813-144	1N1202A, Silicon	1
FUSES			
F1	2483-430	10 Amp, Cartridge	3
INDUCTORS			
L1	4412-047	DC Filter	-
L2	4418-512	DC Filter	-
METERS			
M1	2943-431	0-150 Voltmeter, DC	-
M2	2923-441	0-10 Ammeter, DC	-
RECTIFIERS			
A5	2822-055	30 Amp 400 Volt Bridge	1
RESISTORS			
R1	2635-701	46.4K Ohm 1 Watt, Fixed	1
R2	2615-351	4.7M Ohm 1/2 Watt, Fixed	1
R3	2635-744	332K Ohm 1 Watt, Fixed	1
R4	2652-541	3.9K Ohm 11 Watt, Fixed	1
R5	2651-515	150 Ohm 6.5 Watt, Fixed	1
R6	2615-476	5.6K Ohm 1 Watt, Fixed	1
R7	2615-367	22M Ohm 1/2 Watt, Fixed	1
R8	2635-517	22.1 Ohm 1 Watt, Fixed	1
R11	2652-541	3.9K Ohm 11 Watt, Fixed	*

ELECTRICAL PARTS LIST
LORAIN MODEL HSB6H DC TO DC CONVERTER
SPEC. NO. 5664-023

Ref. Desig.	LPC Part No.	Description	Quantity Recm. Spares
TRANSFORMERS			
T1	4516-009	Power	-
T2	4522-527	Current	-
MISCELLANEOUS			
	2488-141	Fuseholder	1

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Lorain, Ohio, U.S.A.

LORAIN PRODUCTS (CANADA) LTD.
St. Thomas, Ontario, Canada

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rrs

CIRCUIT NOTES:

101. FUSES SHOWN IN THIS TABLE ARE NOT PART OF EQUIPMENT

DESIG	FUSE AMP	POTENTIAL	ONE PER

BATTERY AND POWER SUPPLIES SYMBOLS

VOLTAGE RANGE 40-60

102. UNLESS OTHERWISE SPECIFIED THE FOLLOWING OPTION IS PROVIDED. Y

OPTION	REFERENCES	
	WIRING	CONNECT TB2 JUMPERS
POS OUTPUT	Y	5 TO 9, 6 TO 8, 7 TO 10
NEG OUTPUT	Z	5 TO 7, 6 TO 10, 8 TO 9

103. OPTIONAL FRAME GROUND FOR PROTECTION AGAINST REVERSE BATTERY POLARITY MAY BE REMOVED AFTER INSTALLATION.

EQUIPMENT NOTES:

201. REFER TO PD-5664-023 FOR EXTERNAL CONNECTIONS, FUSING AND WIRE SIZE.

5 | 6 | 7 | 8 | 9

INFORMATION NOTES:

301. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE MICROFARADS, AND VALUES PRECEDED BY THE SYMBOL + (PLUS), OR — (MINUS) ARE IN VOLTS.

302. CODES WITHIN PARENTHESES, AS (4863-760) REPRESENT LPC PART NUMBERS.

303. SEE WIRING DIAGRAM, T-5666-002 FOR LPC PART NUMBERS OF COMPONENTS.

304. HIGHEST REF DESIG. USED ON THIS DRAWING:

RES.	XMFR	DIODES	ASSYS	FUSES	CAP
R11	T2	CR3	A5	F1	C16
NOT USED					
R9,10					

REVISIONS

1 M	NEW		
2	1835633	9 24 75	POLARITY OPTION REVISED.
3	1835779	12 4 75	T2 AND R8 ADDED
4	1835984	3 4 76	A2 WAS 4337-640 P1 AND J1 ADDED
5	1836092	5 17 76	R11 ADDED, J2 AND P2 WERE J1 AND P1

1811152	DESIGN N.KAMMILLER	SH. 5
	DRAWN BY	DATE 6-12-75
	CHECKED BY	DATE 6-12-75
	CHECKED BY N.KAMMILLER	DATE 6-26-75
	APPROVED BY	DATE
	RATING	

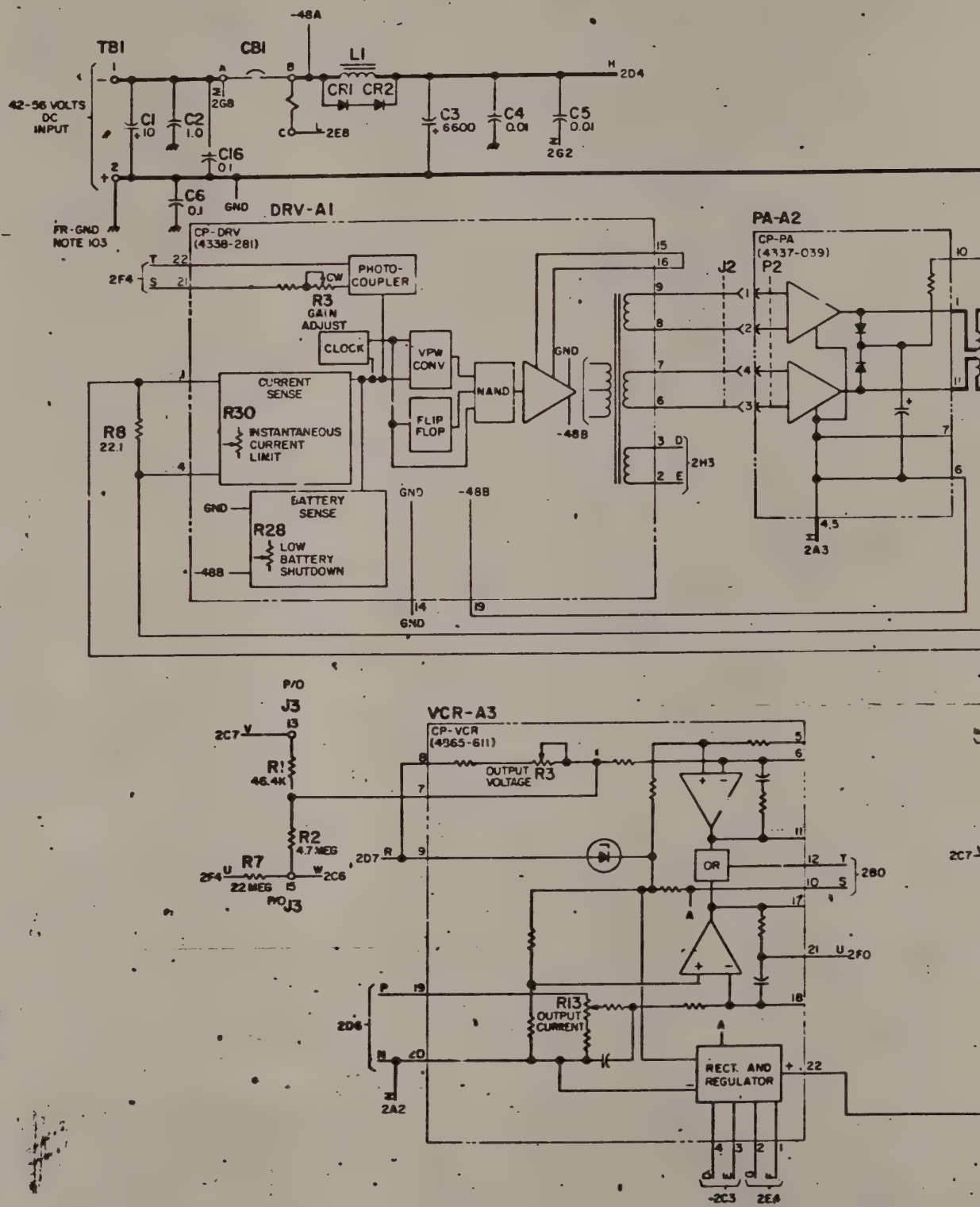
FUNCTIONAL SCHEMATIC FOR DC-DC CONVERTER MODEL HSB6H

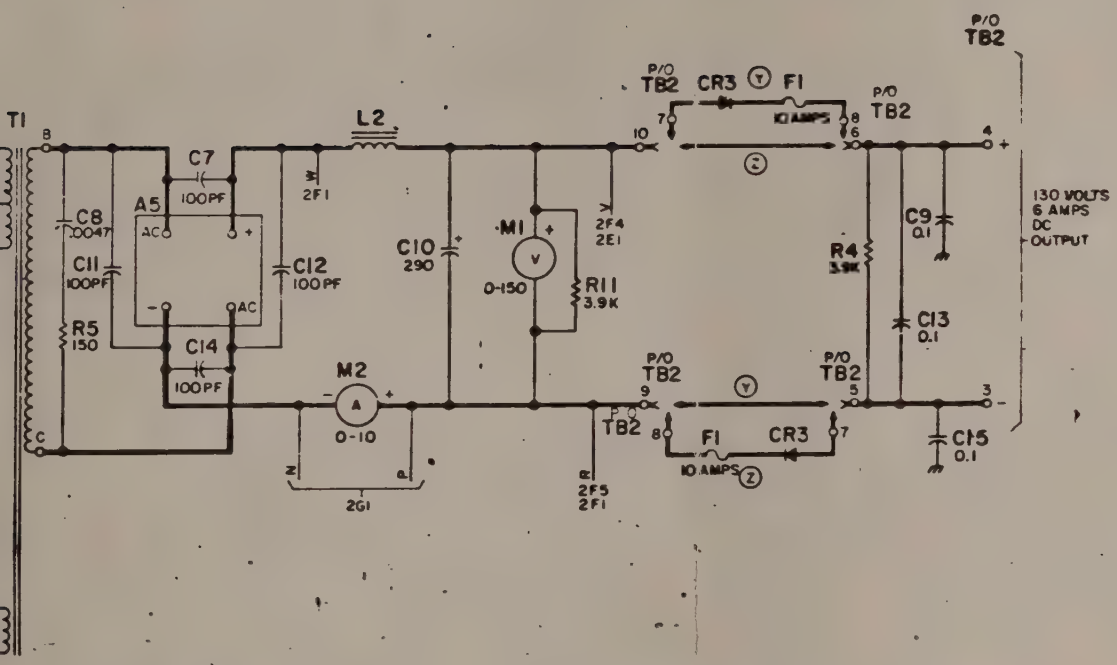
SD-5664-023

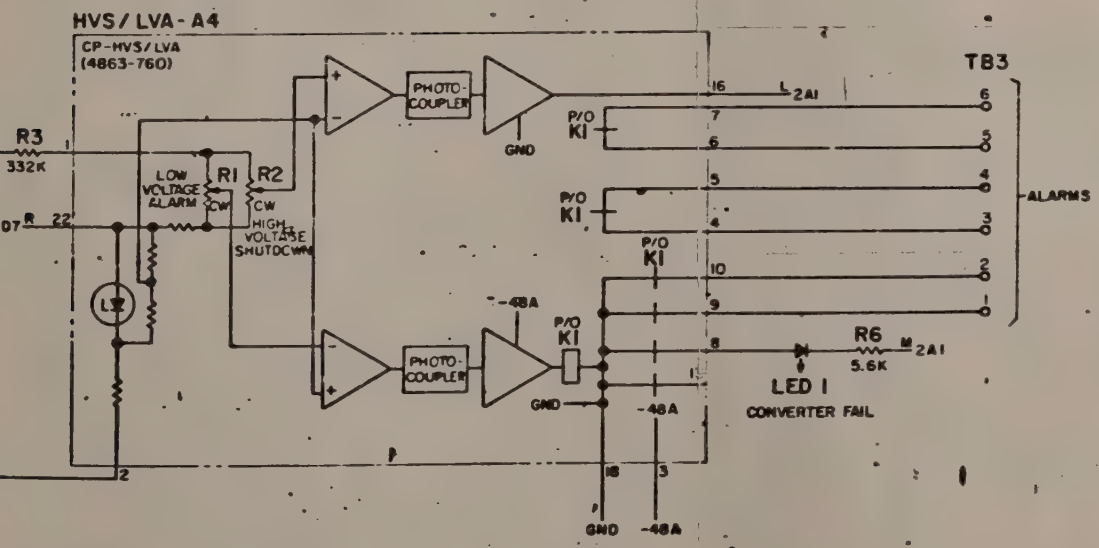
LORAIN PRODUCTS CORPORATION
LORAIN, OHIO

DWG SIZE D

SHEET 1 OF 2


TB1
CB1
L1
-48A
CR1 CR2
42-56 VOLTS DC INPUT
C1 10
C2 1.0
C16 0.1
C6 0.1
GND
C3 6600
C4 0.01
C5 0.01
2D4
2G8
2E8
2G2
FR-GND NOTE 103
DRV-A1
CP-DRV (4338-281)
2F4
PHOTO-COUPLER
R3 GAIN ADJUST
CLOCK
VPW CONV
FLIP FLOP
NAND
CURRENT SENSE
R30
INSTANTANEOUS CURRENT LIMIT
R8 22.1
BATTERY SENSE
R28
LOW BATTERY SHUTDOWN
-48B
PA-A2
CP-PA (4337-039)
J2
P2
2H3
2A3
P/O J3
VCR-A3
CP-VCR (4365-611)
2C7
R1 46.4K
R2 4.7 MEG
R7 22 MEG
2C6
OUTPUT VOLTAGE R3
2D7
OR
2B0
2F0
R13 OUTPUT CURRENT
2D6
RECT. AND REGULATOR
+.22
2A2
-2C3
2E4





MODEL HSB6H	SD-5664-023
LOSAIN PRODUCTS CORPORATION D	SHEET 2

CPS-PA

(POWER AMPLIFIER)

COMPONENT LIST

CAPACITORS

DESIG	CODE
(2) C1,C3	(2724-181) 0.022 UF, 1000V DC
C2	(2731-607) 20 UF, 150V DC, ELECT.

DIODES

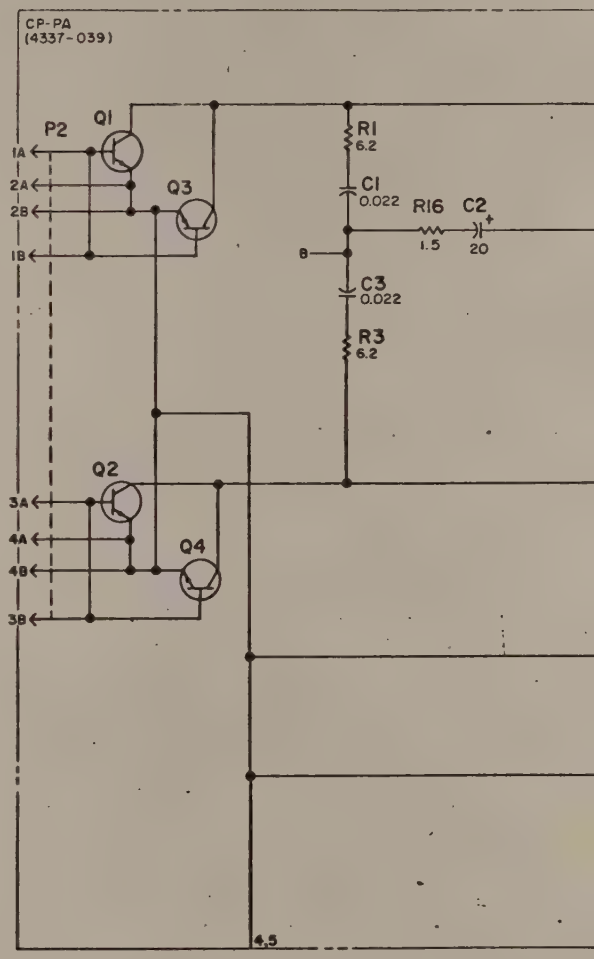
DESIG	CODE
(2) CR1,CR2	(2812-220)

RESISTORS

DESIG	CODE
(2) R1, R3	(2651-466) 6.2 OHM, 6 1/2 W, 5%
R2	(2652-488) 1K, 1W, 5%
R16	(2651-105) 1.5 OHM, 3 W, 5%

TRANSISTORS

DESIG	CODE
(4) Q1,2,3,4	(2842-170)



INPUT/OUTPUT INFORMATION

CIRCUIT DESCRIPTION

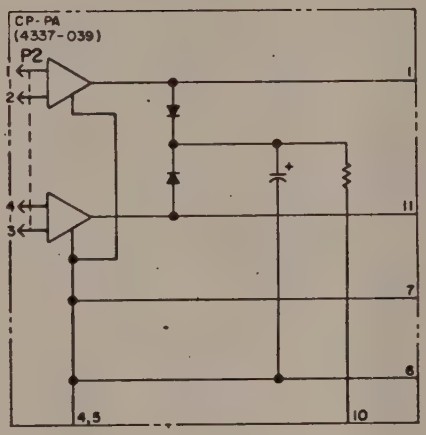
Q1 - Q4 OPERATE IN THE SWITCHING MODE AMPLIFYING A QUASI SQUARE WAVE SIGNAL APPEARING AT 2-3, 8 - 9. R1-R3,C1-C3,CR1,CR2 LIMIT VOLTAGE PEAKS ON Q1-Q4 COLLECTORS.

REVISIONS			
ISS NO.	CHG OF LMC SLIP REQ.	DATE	DESCRIPTION
1	N		NEW

MANUFACTURING REFERENCES

CATEGORY	NUMBER
ASSEMBLY DRAWING	4337-039
CONNECTOR ON FRAME	

SYMBOL



NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS AND CAPACITANCE VALUES ARE IN MICROFARADS; VALUES PRECEDED BY THE SYMBOL + (PLUS), OR - (MINUS), ARE IN VOLTS.
2. CODES WITHIN PARENTHESES, AS (2724-181), REPRESENT LPC PART NUMBERS.

181-1152	DESIGN N KAMMILLER	ISS. 1
POWER AMPLIFIER ASSEMBLY	DRAWN BY E GAETANO DATE 3-8-76	
	CHECKED BY R O DATE 3-8-76	
	CHECKED BY G. SOUNICK DATE 4-15-76	
	APPROVED BY DATE 4-21-76	
	RATING STANDARD	
	SD-4337-039	
LORAIN PRODUCTS CORPORATION LORAIN, OHIO	DWG SIZE D	SHEET 1 OF 1

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COMPONENT LIST

CAPACITORS

DESIG	CODE
(2) C1,4	(2724-148) 3300 PF, 1000V DC
C2	(2731-129) 50UF, 25V DC, ELECT.
C3	(2724-146) 680 PF, 1000V DC
(2) C5,C12	(2713-118) 0.01UF, 100V DC
C6	(2737-129) 2.2UF, 35V DC, TANTALUM
(3) C7,8,14	(2713-205) 0.0022UF, 200V DC
(2) C9,10	(2724-106) 0.1UF, 500V DC
C11	(2731-115) 30UF, 60V DC, ELECT.
C13,15	(2737-141) 47UF, 20V DC, TANTALUM

DIODE

DESIG	CODE
(11) CR1,2,3,4,5,6,7,8,15,18,19	(2811-101)
(6) CR9,10,20,21,22,23	(2812-220)
(5) CR11,12,13,14,24	(2834-412)
CR16	(2812-201)
CR17	(2835-411)

INTEGRATED CIRCUITS

DESIG	CODE
A1	(2871-004) DUAL TIMER
A2	(2876-101) DUAL FLIP-FLOP
A3	(2876-302) TRIPLE NAND
A4	(2876-401) QUAD BUFFER

RESISTORS

DESIG	CODE
R1	(2662-408) 5.1 OHM,2W,5%
R2	(2615-257) 560 OHM,1/2 W
R3	(2675-117) 5K,1/2 W
R5	(2635-678) 12.7K,1W,1%
(3) R6,11,18	(2615-255) 470 OHM,1/2 W
(2) R7,17	(2651-339) 1.5K,3W,5%
(3) R8,16,22	(2615-271) 2.2K,1/2W
(2) R9,14	(2615-291) 15K,1/2W
(2) R10,13	(2615-263) 1K,1/2W
R12	(2635-717) 100K,1W,1%
R15	(2636-636) 1.68K 1W,1%
R19	(2634-623) 3.32K,1/4W,1%
R20	(2651-550) 1.5K, 6-1/2W,5%
R21	(2634-632) 4.75K, 1/4W,1%
R23	(2615-205) 2.7 OHM, 1/2W
R24	(2615-303) 47K, 1/2W
R25	(2615-295) 22K, 1/2W
R26	(2635-647) 2.94K, 1W, 1%
R27	(2615-255) 470 OHM, 1/2W
R28	(2675-113) 1K, 1/2W
R29	(2634-648) 10K, 1/4W, 1%
R30	(2675-114) 2K, 1/2W
R31	(2634-582) 475 OHM, 1/4W, 1%
R4	(2651-305) 3 OHM, 3W
R32	(2634-682) 51.1K,1/4W,1%

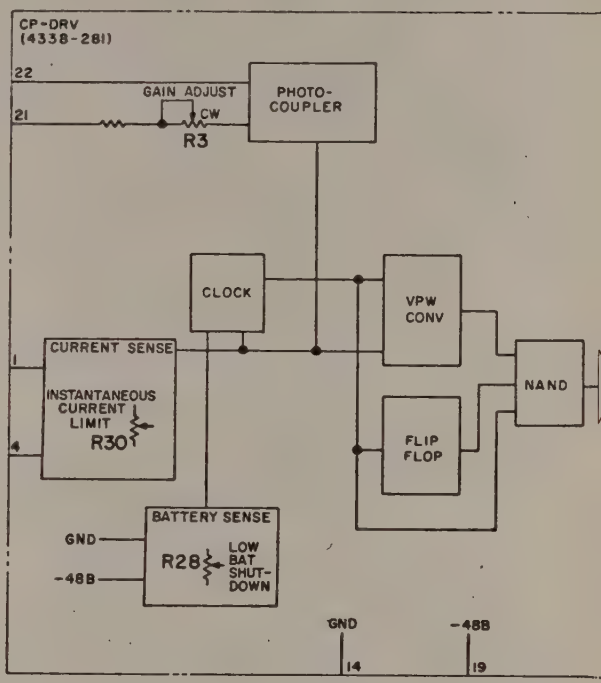
TRANSFORMERS

DESIG	CODE
T1	(4481-015)

TRANSISTORS

DESIG	CODE
Q1	(2857-101) PHOTO COUPLER
(2) Q2,5	(2844-010) PNP
(5) Q3,4,6,7,8	(2841-155) NPN
(2) Q9,10	(2841-100) NPN

SYMBOL

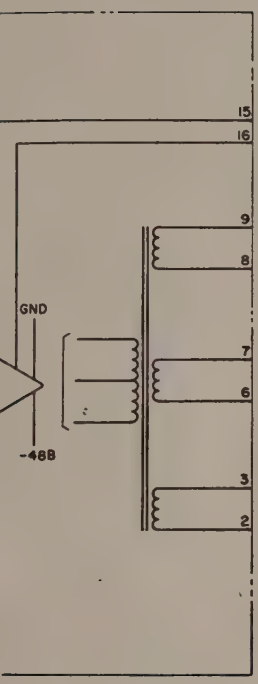


INPUT/OUTPUT INFORMATION

CIRCUIT DESCRIPTION

A1 CLOCK GENERATES 40 KHZ PULSE WHICH STARTS RAMP GENERATED IN A1 VOLTAGE/PULSE WIDTH CONVERTER. RAMP SLOPE OF VPW CONV. IS DETERMINED BY CURRENT THRU R12 PROPORTIONAL TO BATTERY VOLTAGE. PULSE WIDTH OUT OF VPW CONV. IS DETERMINED BY RAMP SLOPE AND CONDUCTION OF Q1, WHICH IS CONTROLLED BY REGULATOR CKT AND Q6, WHICH IS CONTROLLED BY INSTANTANEOUS COLLECTOR CURRENT IN POWER AMPLIFIER. A2 FLIP FLOP GENERATES 20 KHZ SQUARE WAVE FROM CLOCK PULSE. CLOCK PULSE, VPW CONV. OUTPUT AND SQUARE WAVE ARE COMBINED IN A3 NAND GATE TO FORM TWO OUT OF PHASE WIDTH VARIABLE QUASI SQUARE WAVES AND THEIR COMPLEMENT WHICH ARE BUFFERED BY A4. THE QUASI SQUARE WAVES ARE AMPLIFIED BY Q2, Q3, Q4, Q5 OPERATING IN THE CONSTANT CURRENT MODE. THE COMPLEMENT IS AMPLIFIED BY Q7, Q8 OPERATING AS A CLAMP ON T1 TRANSFORMER PRIMARY. CR12-CR14 DEVELOPE BIAS FOR AMPLIFIER TRANSISTORS AND SUPPLY VOLTAGE FOR A1-A4 CIRCUITS. WINDINGS 1,2 AND 3,4 PRODUCE BASE DRIVE VOLTAGE. WINDING 9,10 DEVELOPES POWER TO OPERATE REGULATOR AND ALARM CIRCUITS.

R26,R28 FORMS A VOLTAGE DIVIDER NETWORK WITH REFERENCE CR17 TO CONTROL Q10 UNTIL BATTERY IS SUFFICIENTLY HIGH ALLOWING VPW CONV. TO INCREASE CURRENT TRANSFORMER LOCATED IN POWER C6 VOLTAGE EXCEEDS REFERENCE CR17, CR18 AND CLOCK FREQUENCY THRU Q10



MANUFACTURING REFERENCES

CATEGORY	NUMBER
ASSEMBLY DRAWING	4338-281
CONNECTOR ON FRAME	2475-772

NOTES:
1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS AND CAPACITANCE VALUES ARE IN MICROFARADS; VALUES PRECEDED BY THE SYMBOL + (PLUS), OR — (MINUS), ARE IN VOLTS.
2. CODES WITHIN PARENTHESES, AS (2662-408) REPRESENT LPC PART NUMBERS.

REVISIONS

REV NO.	ISSUED BY	DATE	DESCRIPTION
1	M		NEW
2	1835693	12	R15 WAS 1.8K, 1/2W,
		12	C11 WAS 100UF, 100V,
		75	R24-R28, C13, CR15-CR17, Q9 AND Q10 ADDED, C6 WAS 0.33UF, 35V, CR11 WAS 2811-435, R19 WAS 47 OHM, 1/2W, R21 WAS 1 OHM, 1/2W, C14, CR18-23, R29-R31 ADDED
3	1835984	3	C13 WAS 2737-139
		9	R4 WAS 2662-408
		76	C14 WAS 2724-145 CR24 ADDED. R20 WAS 2651-344 CONNECTOR WAS 2475-776
			R32 ADDED G. Sobecka 6-29-76
			ISS NC 4 N836237 D.S. 6-28-76
A1			WAS 2871-002 NOTED, R15 WAS 2635-632 G. Sobecka 11-1-76 ISS. 5 N1836330 SK 10-26-76
6	M836471	12/5/77	C 5 ADDED, A1 WAS 2871-003 G. Sobecka 12-15-77

OSS BATTERY THE OUTPUT OF WHICH IS COMPARED AND Q9. Q9 MAINTAINS C13 AT A LOW VOLTAGE TO ALLOW STARTING AT WHICH TIME C13 CHARGES E WIDTH. CR20-CR23 RECTIFY OUTPUT OF EXTERNAL R AMPLIFIER CIRCUIT AND PEAK CHARGE C6. WHEN Q6 CONDUCTS REDUCING CONDUCTION ANGLE THRU AND R19.

181-1081

DRIVER

DESIGN	N. KAMMILLER	ISS. 6
DRAWN BY	J. DAAR	DATE 4-16-75
CHECKED BY	G. Sobecka	DATE 4-21-75
CHECKED BY	N. KAMMILLER	DATE 4-26-75
APPROVED BY		DATE 4-28-75
RATING		

SD-4338-281

LORAIN PRODUCTS CORPORATION
LORAIN, OHIO
LORAIN PRODUCTS (CANADA) LTD., ST. THOMAS, ONTARIO

DWG SIZE D

SHEET 1 OF 2

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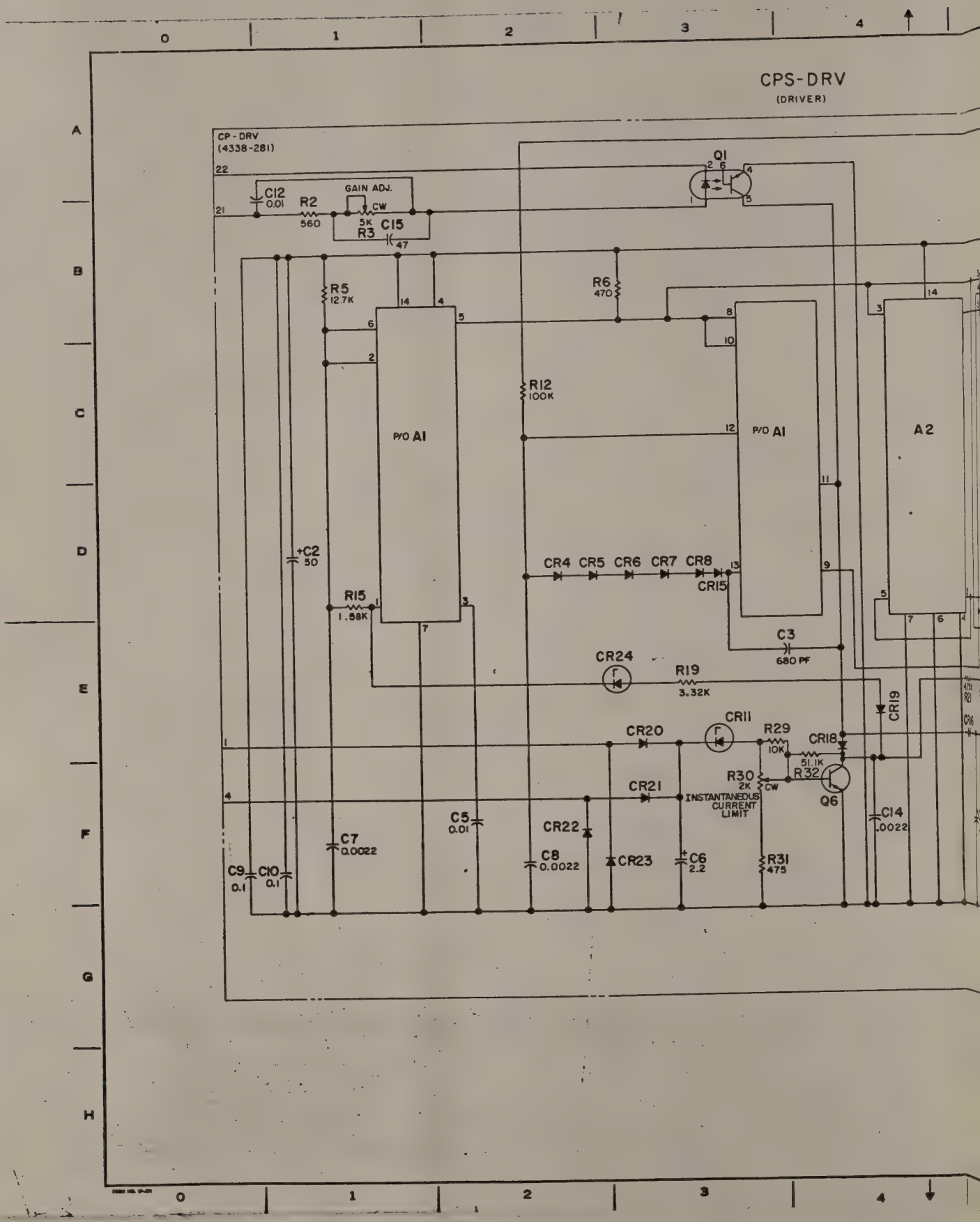
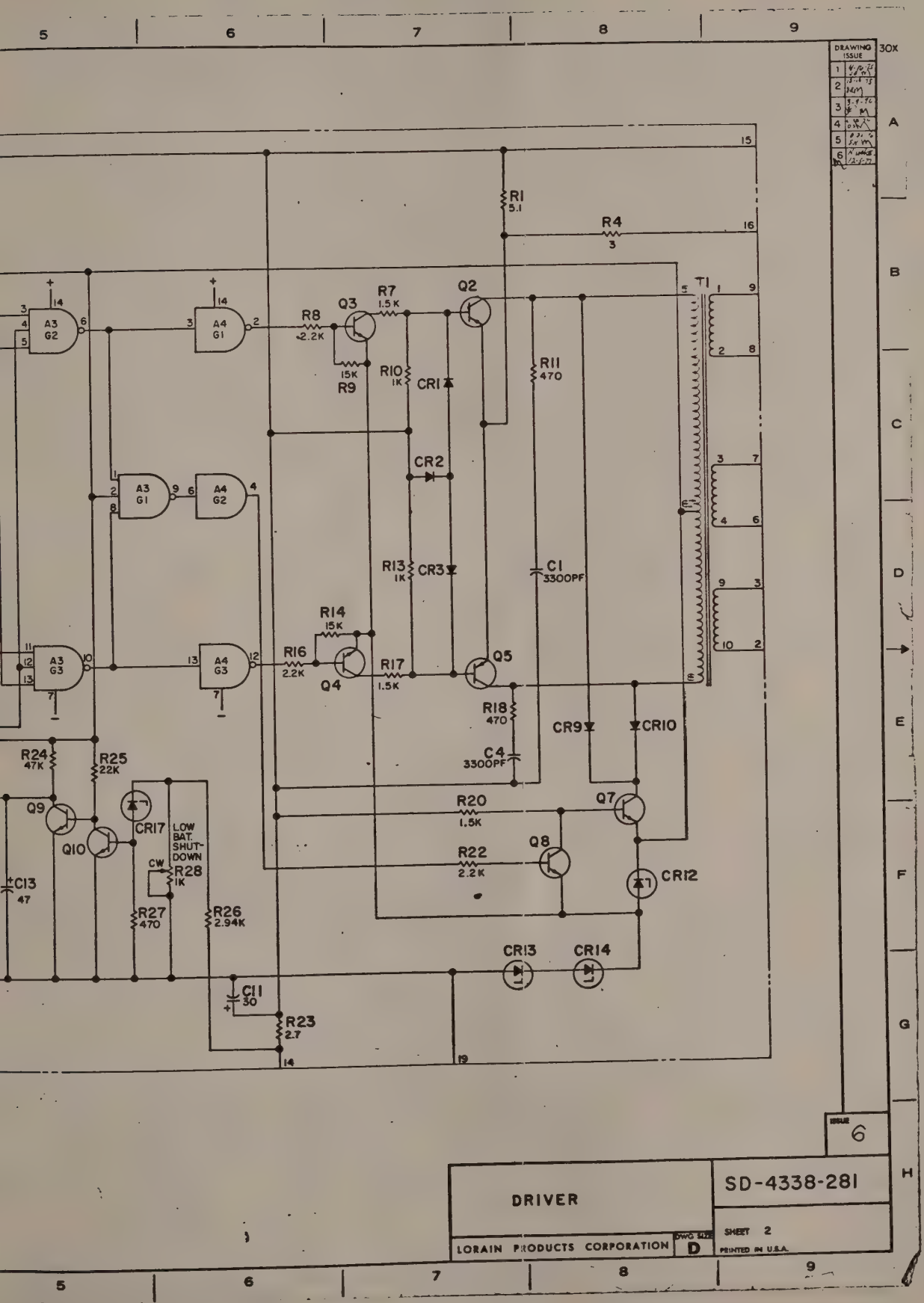

CPS-DRV
(DRIVER)
CP-DRV
(4338-281)
Q1
C12
0.01
R2
560
GAIN ADJ.
5K
CW
R3
C15
47
R5
12.7K
R6
470
R12
100K
P/O A1
P/O A1
A2
+C2
50
R15
1.58K
CR4 CR5 CR6 CR7 CR8
CR15
C3
680 PF
CR24
R19
3.32K
CR19
CR11
CR20
R29
10K
CR18
51.1K
R30
2K
CW
R32
Q6
CR21
INSTANTANEOUS
CURRENT
LIMIT
C14
.0022
C5
0.01
CR22
C7
0.0022
C8
0.0022
CR23
C6
2.2
R31
475
C9
0.1
C10
0.1


5
6
7
8
9
A
B
C
D
E
F
G
H
DRAWING ISSUE
30X
1
2
3
4
5
6
R1
5.1
R4
3
T1
Q2
Q3
R7
1.5K
R8
2.2K
R9
15K
R10
1K
CR1
R11
470
CR2
R13
1K
CR3
C1
3300PF
R14
15K
R16
2.2K
Q4
R17
1.5K
Q5
R18
470
C4
3300PF
CR9
CR10
R20
1.5K
Q7
R22
2.2K
Q8
CR12
CR13
CR14
R24
47K
R25
22K
Q9
Q10
CR17
LOW BAT. SHUT-DOWN
CW
R28
1K
R27
470
R26
2.94K
C13
47
C11
30
R23
2.7
A3 G2
A4 G1
A3 G1
A4 G2
A3 G3
A4 G3
ISSUE
6
DRIVER
SD-4338-281
LORAIN PRODUCTS CORPORATION
DWG SIZE
D
SHEET 2
PRINTED IN U.S.A.

CPS-VCR

(VOLTAGE AND CURRENT REGULATOR)

COMPONENT LIST

CAPACITORS

DESIG	CODE	
(2) C1,5	(2724-106)	0.1 UF, 500V DC
(2) C2,6	(2713-132)	0.1 UF, 100V DC
C3	(2724-140)	0.01UF, 1000V DC
C4	(2731-105)	10UF, 50V DC, ELECT.
C7	(2713-142)	0.22UF, 100V DC
C8	(2731-225)	1100UF, 40V DC, ELECT.
C9	(2724-125)	220PF, 500V DC
C10	(2713-108)	0.001UF, 100V DC

DIODES

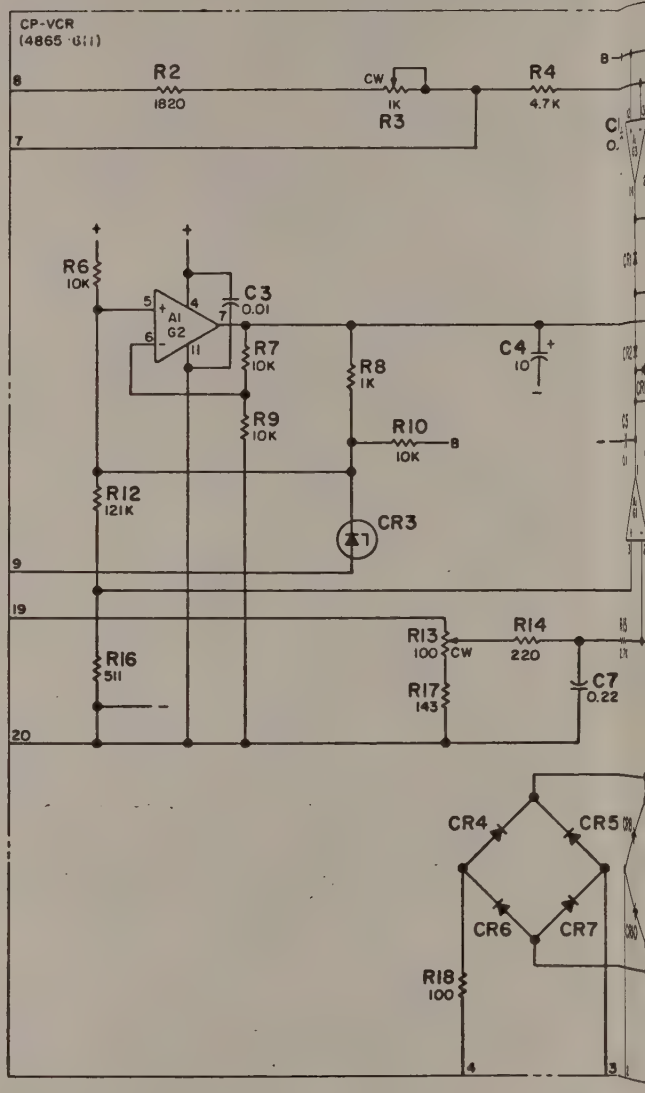
DESIG	CODE	
(11) CR1,2,4,5,6,7,12-16	(2811-101)	
CR3	(2835-325)	6.2V, 0.4 W, ZENER
(4) CR8,9,10,11	(2812-220)	

INTEGRATED CIRCUITS

DESIG	CODE
A1	(2871-115)

RESISTORS

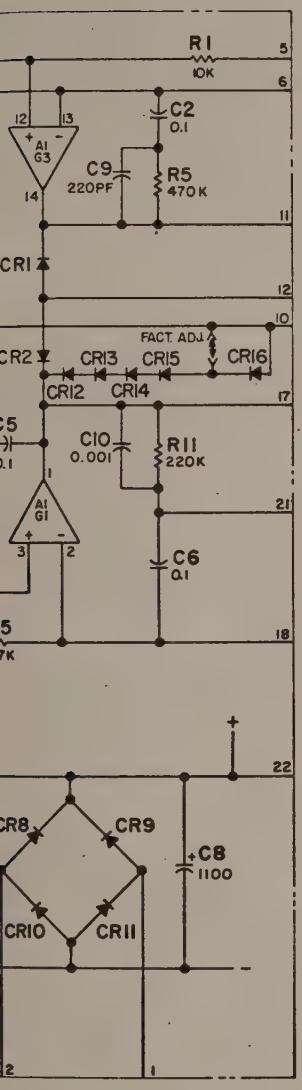
DESIG	CODE	
(2) R1,10	(2635-673)	10K, 1W, 1%
R2	(2635-637)	1820 OHM, 1W, 1%
R3	(2675-113)	1K, 1/2W, POT.
R4	(2615-279)	4.7K, 1/2W
R5	(2615-327)	470K, 1/2W
(3) R6,7,9	(2615-287)	10K, 1/2W
R8	(2635-624)	1K, 1W, 1%
R11	(2615-319)	220K, 1/2W
R12	(2635-721)	121K, 1W, 1%
R13	(2675-104)	100 OHM, 1/2W, POT.
R14	(2615-247)	220 OHM, 1/2W
R15	(2615-273)	2.7K, 1/2W
R16	(2635-610)	511 OHM, 1W, 1%
R17	(2635-556)	143 OHM, 1W, 1%
R18	(2615-239)	100 OHM, 1/2W



INPUT/OUTPUT INFORMATION

CIRCUIT DESCRIPTION

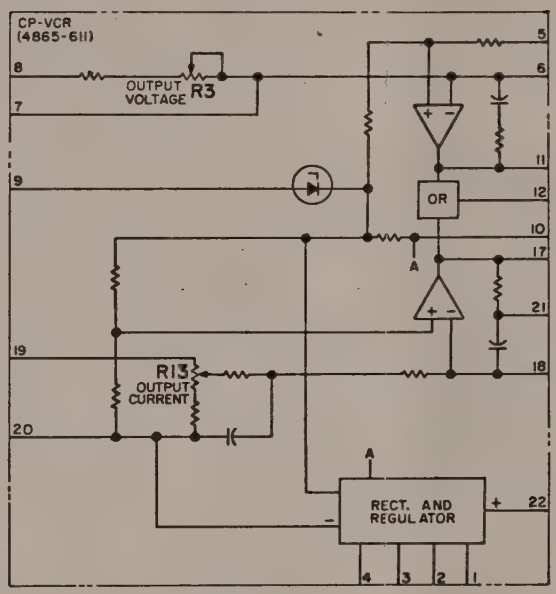
AIG1 COMPARES SIGNAL DEVELOPED ACROSS R2, R3 PROPORTIONAL TO OUTPUT VOLTAGE WITH REFERENCE DEVELOPED ACROSS CR3. AIG2 COMPARES SIGNAL DEVELOPED ACROSS R13, R17 PROPORTIONAL TO OUTPUT CURRENT WITH REFERENCE DEVELOPED ACROSS R16. COMPARATOR OUTPUTS ARE CONNECTED FOR "OR" OPERATION BY DIODES CR1, CR2. DIODE OUTPUT DRIVES OFF BOARD PHOTO ISOLATOR. AIG3 FUNCTIONS AS A SERIES REGULATOR FOR ISOLATED SUPPLY VOLTAGE DEVELOPED ACROSS C5 AND SUPPLIES PHOTO ISOLATOR AND CR3 REFERENCE. CR4-CR11 COMPRISE ALTERNATE RECTIFIERS FOR 20KHZ POWER FROM DRIVER AND OUTPUT CIRCUITS. CR12-CR16 CLAMP OUTPUT OF AIG1 TO LIMIT DEPTH OF CURRENT LIMIT RANGE.



MANUFACTURING REFERENCES

CATEGORY	NUMBER
ASSEMBLY DRAWING	4865-611
CONNECTOR ON FRAME	2475-776

SYMBOL



NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, AND CAPACITANCE VALUES ARE IN MICROFARADS; VALUES PRECEDED BY THE SYMBOL + (PLUS), OR - (MINUS), ARE IN VOLTS.
2. CODES WITHIN PARENTHESES, AS (2713-142), REPRESENT LPC PART NUMBERS.

REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
1	NEW		
A	CR12-CR16 ADDED ISS 2 183-6206 J.R. 9-16-76		

181-1152

VOLTAGE AND CURRENT REGULATOR

DESIGN	N. KAMMILLER	ISS. 2
DRAWN BY	J. BAAR	DATE 9-15-75
CHECKED BY	W. Langdon	DATE 9-15-75
CHECKED BY	N. KAMMILLER	DATE 9-26-75
APPROVED BY	J.W. Ehl	DATE 9-27-75
RATING		

SD-4865-611

LORAIN PRODUCTS CORPORATION
LORAIN, OHIO

DWG SIZE D

SHEET 1 OF 1

PRINTED IN U.S.A.

CPS-HVS/LVA

(HIGH VOLTAGE SHUTDOWN - LOW VOLTAGE

COMPONENT LIST

CAPACITOR

DESIG	CODE
C1	(2713-132) 0.1 UF, 100 VDC
C2	(2731-103) 10 UF, 100 VDC, ELECT.
C3	(2724-140) 0.01UF, 1000 VDC

DIODES

DESIG	CODE
(2) CR1,2	(2812-223)
CR3	(2835-325) 6.2V, 400MW, ZENER

INTEGRATED CIRCUITS

DESIG	CODE
A1	(2871-115) QUAD OP-AMP

RELAYS

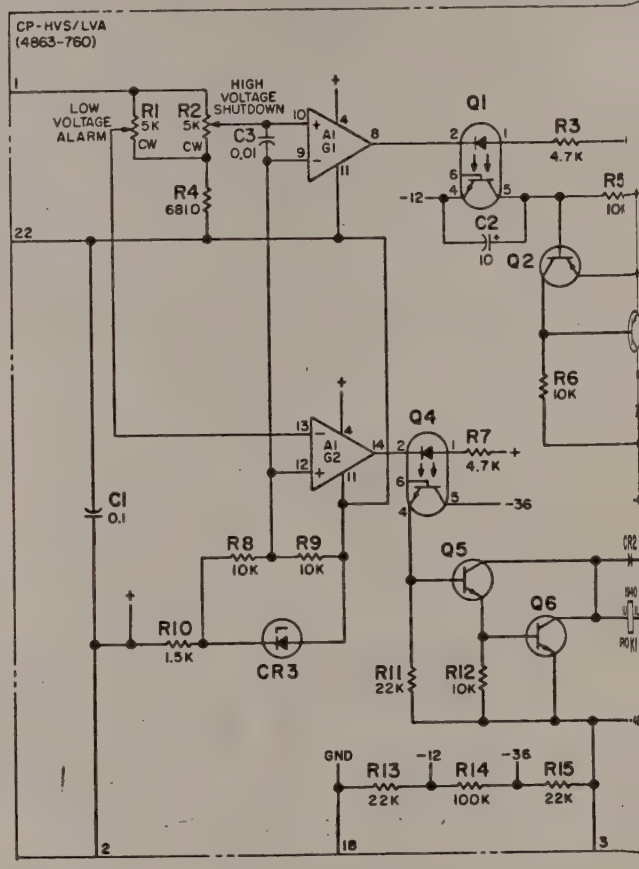
DESIG	CODE
K1	(2543-443) 1940 OHM, 62V, COIL

RESISTORS

DESIG	CODE
(2) R1,2	(2675-117) 5K, 1/2W, POT.
(2) R3,7	(2615-279) 4.7K, 1/2W
R4	(2635-665) 6810 OHM, 1 W, 1%
(2) R5,12	(2615-287) 10K, 1/2W
R6	(2615-487) 10K, 1W
(2) R8,9	(2635-673) 10K, 1W, 1%
R10	(2615-267) 1.5K, 1/2W,
(3) R11,13,15	(2615-295) 22K, 1/2W
R14	(2615-311) 100K, 1/2W

TRANSISTORS

DESIG	CODE
(2) Q1,4	(2857-101) PHOTO-COUPLER
Q2	(2843-151) PNP
Q3	(2843-041) PNP
(2) Q5,6	(2841-102) NPN



INPUT/OUTPUT INFORMATION

CIRCUIT DESCRIPTION

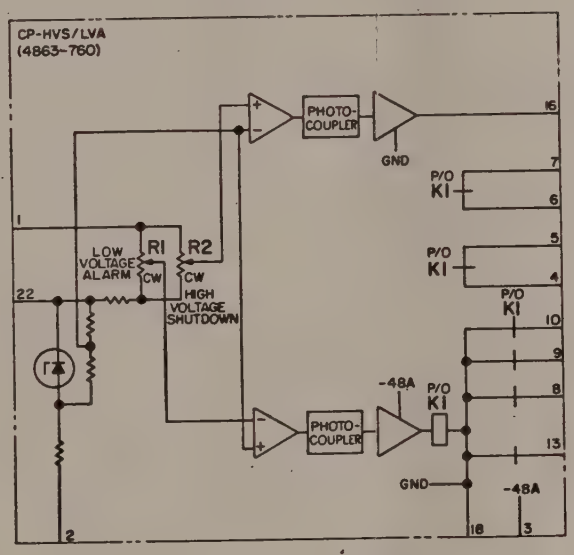
A PORTION OF OUTPUT VOLTAGE IS DEVELOPED ACROSS R1, R2, R4. IT IS COMPARED WITH REFERENCE DEVELOPED ACROSS CR3 AT A1, G1 AND G2. A1, G1 OUTPUT IS ISOLATED BY Q1 AND AMPLIFIED BY Q2, Q3 TO ENERGIZE COIL OF VOLTAGE TRIP INPUT CIRCUIT BREAKER ON OVERVOLTAGE CONDITION. A1, G2 OUTPUT IS ISOLATED BY Q4 AND AMPLIFIED BY Q5, Q6 TO ENERGIZE K1 LOW VOLTAGE ALARM RELAY.

REVISIONS			
NO.	LTR. SYM. INCL. SUP. NO.	DATE	DESCRIPTION
1	M		NEW
2	1835633	9 23 75	CONTACT SET ADDED. G. Sobotka 9-26-75 J. Mitchell
3	1835779	12 2 75	"A" DESIGNATION ADDED TO BATTERY SYMBOL J. Mitchell
4	1835984	3 15 76	C3 ADDED. CONNECTOR WAS 2475-776 J. Mitchell

MANUFACTURING REFERENCES

CATEGORY	NUMBER
ASSEMBLY DRAWING	4863-760
CONNECTOR ON FRAME	2475-772

SYMBOL



NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS AND CAPACITANCE VALUES ARE IN MICROFARADS: VALUES PRECEDED BY THE SYMBOL + (PLUS), OR — (MINUS), ARE IN VOLTS.
2. CODES WITHIN PARENTHESES, AS (2713-132), REPRESENT LPC PART NUMBERS.

181-1152	DESIGN N. KAMMILLER	SH. 4
HIGH VOLTAGE SHUTDOWN- LOW VOLTAGE ALARM	DRAWN BY J. Bond — DATE 4-21-75 CHECKED BY — DATE 4-21-75 CHECKED BY N. KAMMILLER — DATE 7-26-75 APPROVED BY J. Mitchell — DATE 9-8-75 RATING	
LORAIN PRODUCTS CORPORATION LORAIN, OHIO LORAIN PRODUCTS (CANADA) LTD., ST. THOMAS, ONTARIO	DWG SIZE D	SD-4863-760 SHEET 1 OF 1

PRINTED IN U.S.A.

| SD-DRAWING ISSUES AND T-DRAWING ISSUES AS FOLLOWS: | | |

5 | 6 | 7 | 8 | 9

MANUFACTURING NOTES:

1. ALL WIRES TO BE 20 GA SOLID UNLESS OTHERWISE SPECIFIED.
2. BI - TERMINAL NEAREST MOUNTING SURFACE
3. 2 TW - TWO WIRES SHALL BE TWISTED TOGETHER.
4. D - INDICATES LEAD IS A JUMPER
5. PT - LEADS WHICH ARE PART OF COMPONENTS OR SUBASSEMBLIES
6. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS.
7. SPLICE CR1 AND CR2 TOGETHER WITH LPC PT NO. 2467-352, PARALLEL SPLICE, LUG ENDS WITH LPC PT NO. 2453-097 RING LUG AND SLEEVE WITH LPC PT NO. 1675-366 SLEEVING
8. UNDER L1, L2 AND T1 USE (1 EACH) NO 8 GND WASHER, LPC PT NO. 2156-405
9. SLEEVE ALL PT COMPONENTS WITH LPC PT NO 1675-356 SLEEVING.
10. WIRES SHALL NOT BE CONNECTED UNTIL SHOP TESTS ARE COMPLETED
11. DIODE CR3 TO BE MOUNTED WITH DIODE INSULATING HARDWARE.
12. WIRES TO BE RUN THROUGH T2 AS SHOWN IN DETAIL "B"; SECURE T2 TO WIRES WITH TYRAPS
13. REMOVE LUGS FROM T2 FOR SOLDERING TO J1
14. LUG TOGETHER WITH LPC PT. NO. 2453-664 LUG.

ENGINEERING NOTES:

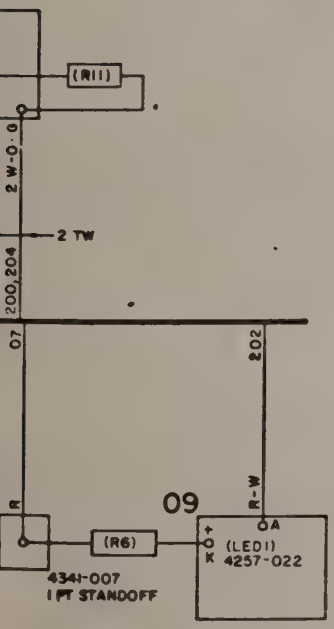
51. OUTPUT POLARITY ADJUSTMENT

TB2 TERMINAL STRIP		
WIRE	POSITIVE OUTPUT	NEGATIVE OUTPUT
JUMPERS	5-9, 6-8, 7-10	5-7, 6-10, 8-9

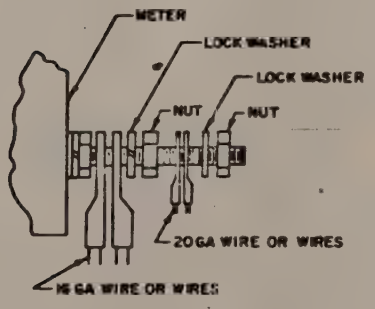
UNLESS OTHERWISE SPECIFIED THE OUTPUT WILL BE CONNECTED FOR POSITIVE OUTPUT

REVISIONS

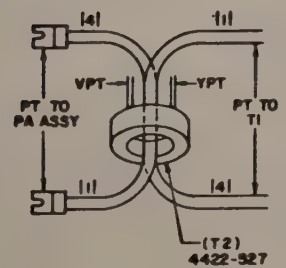
			DESCRIPTION
2	M1835633	10 2 75	REDRAWN; POLARITY OPTION REVISED, METERS CHANGED
3	1835779	12 2 75	R8 AND T2 ADDED NOTES 12 AND 13 ADDED; DETAIL "B" ADDED
4	1835984	3 3 76	A2 WAS 4337-640 P1 AND J1 ADDED
5	1836092	5 17 76	R11 ADDED, J1, J3, J4 WERE 2475-776, P2 AND J2 WERE P1 AND J1.
			PCL KEY WAS 2478-527 ISS 6 1836326 J R. 10-18-75
7	1836438	11/4/77	A5 WAS 2822-025, NOTE 14 ADDED



DETAIL "A"



DETAIL "B"



DESIGN	R LANGWORTHY
DRAWN BY	
CHECKED BY	G SOBOTKA
CHECKED BY	N. KAMMILLER
APPROVED BY	J MITCHELL
RATING	STANDARD
ISS	7
DATE	5-26-75 / 6-26-75 / 9-8-75

WIRING DIAGRAM FOR MODEL HSB6H

T-5664-023

LORAIN PRODUCTS CORPORATION
LORAIN, OHIO

DWG SIZE D

30X

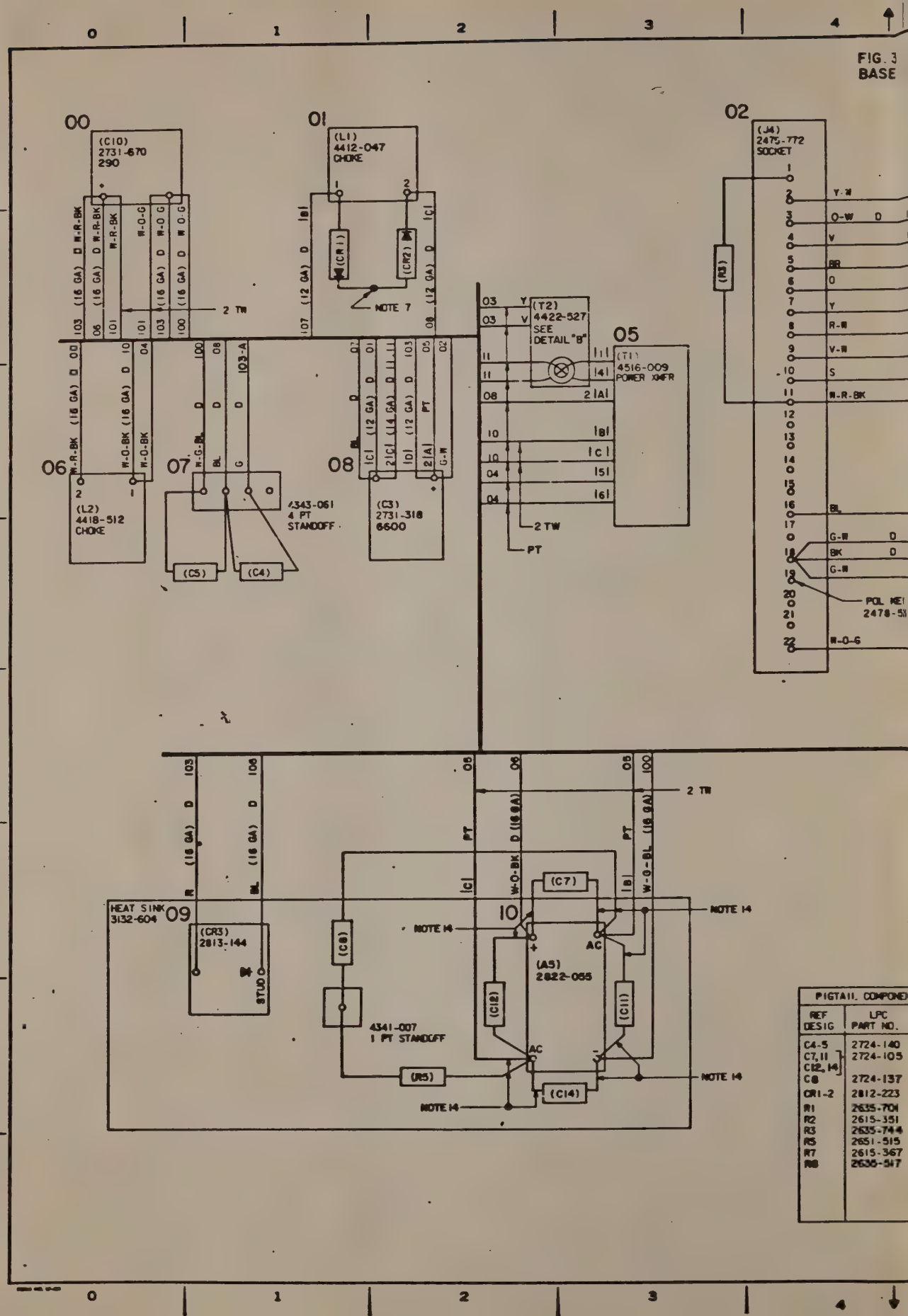
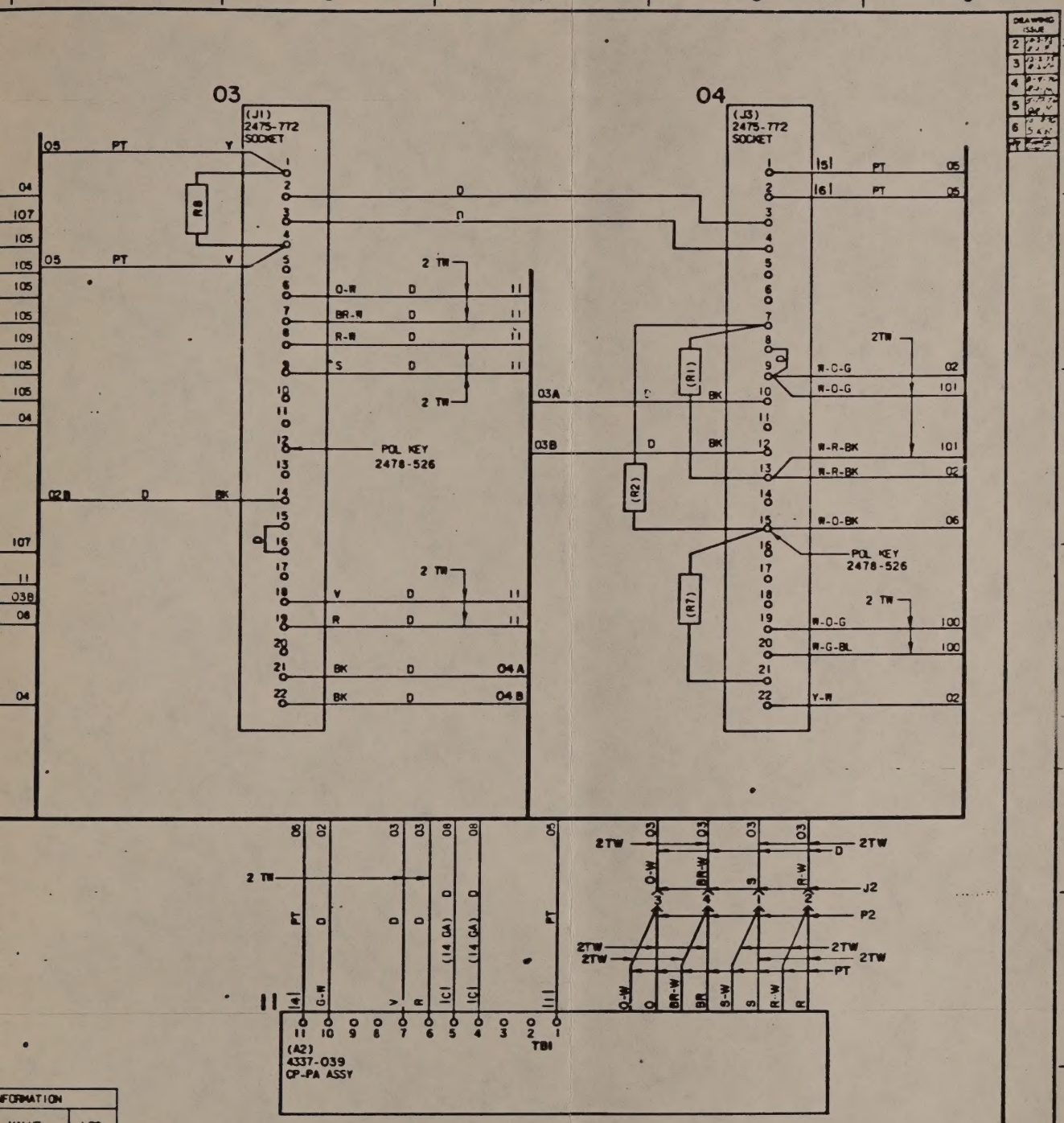


FIG. 3
BASE
00
(C10)
2731-670
290
01
(L1)
4412-047
CHOKE
02
(J4)
2475-772
SOCKET
(R3)
(CR1)
(CR2)
NOTE 7
2 TW
03
(T2)
4422-527
SEE
DETAIL "B"
05
(T1)
4516-009
POWER XMFR
PT
06
(L2)
4418-512
CHOKE
07
4343-061
4 PT
STANDOFF
(C5)
(C4)
08
(C3)
2731-318
6600
POL KEY
2478-5
09
HEAT SINK
3132-604
(CR3)
2813-144
STUD
10
(C7)
(C8)
(A5)
2822-055
(C12)
(C11)
4341-007
1 PT STANDOFF
(R5)
(C14)
NOTE 14
PIGTAIL COMPONEN
REF DESIG
LPC PART NO.
C4-5 2724-140
C7, 11 2724-105
C12, 14
C8 2724-137
CR1-2 2812-223
R1 2635-701
R2 2615-351
R3 2635-744
R5 2651-515
R7 2615-367
R8 2636-547



INFORMATION	
VALUE	LOC
0.01	07
100 PF	10
0.0047	10
	01
46.4 K	04
4.7 MEGO	04
332 K	02
150	10
22 MEGO	04
22.1	03

MODEL HSB6H		T-5664-023
LORAIN PRODUCTS CORPORATION	DWG SIZE D	SHEET 2
		PRINTED IN U.S.A.

82018